and neighbouring shores, and in some instances continued for a considerable period, having been discussed by Mr. D. Ross of the Hydrographer's Office, with great labour and perseverance, a brief statement of the results which his labours afford is here presented by Dr. Whewell.

The discussions here referred to relate to the height of high water, and the variations which this height undergoes in proceeding from springs to neaps, and from neaps to springs. It is found, by examining the observations at 120 places, and throwing the heights into curves, that the curve is very nearly of the same form at all these places. Hence the semi-mensual series of heights at any place affords a rule for the series of heights at all other places where the difference of spring height and neap height is the same. For instance, Portsmouth, where the difference of spring height and neap height is 2 ft. 8 in., is a rule for Cork, Waterford, Inverness, Bantry, Arcachan on the French coast, and other places: and the tables of the heights of high water at one of these places suffices for all the others, a constant being of course added or subtracted according to the position of the zero-point from which the heights at each place are measured.

The series of heights of high water for a semi-lunation also agrees very exactly, as to the form of the curve, with the equilibrium theory. A very simple construction is given for the determination of this curve. The properties deduced according to theory from this construction are, however, in actual cases, modified in a manner which is then described.

1. The tides in these discussions are not referred to the transit of the moon immediately preceding, but to some earlier transit, namely, the second, third, fourth or fifth preceding transit, it being found that in this way the accordance with the theory becomes more exact.

2. According to this construction, the difference of springs and neaps would be to the height of neaps above low water springs as 10 to 24, a constant ratio for all places; but in fact this ratio is different at different places: and the observations under consideration show that the ratio is smaller where the tide is smaller.

In consequence of the law of the high water, given alike by the theory and by the observations, the spring high waters are above the mean high water for a longer period than the neaps are below it.

February 7, 1850.

Sir BENJAMIN C. BRODIE, Bart., Vice-President, in the Chair.

The following papers were read:—

1. "On the development and homologies of the Molar Teeth of the Wart-Hogs (Phacochærus), with illustrations of a System of

Notation for the Teeth in the Class Mammalia." By Richard Owen, Esq., F.R.S. &c.

The author commences by a brief statement of the facts and conclusions recorded in a paper by Sir Ev. Home on the dentition of the *Sus Æthiopicus*, in the Philosophical Transactions for 1799, p. 256; and gives the results of an examination of the original specimens described and figured by Home, and of other specimens showing earlier stages of dentition, which lead to the following conclusions as to the number, kinds, and mode of succession of the teeth in the genus *Phacochærus.* The tooth answering to the first milk-molar and first premolar in the upper jaw, and those answering to the first and second milk-molars and corresponding premolars in the lower jaw of the common Hog are not developed. Eight successive phases of development of the grinding teeth of the African Wart-hogs are described and expressed by the following notation :—

Phase.	No. of grinding teeth.		Kinds of teeth.
I.	$\frac{5-5}{4-4}$	viz.	$\left\{\begin{matrix} d\,2,\ d\,3,\ d\,4,\ m\,1,\ m\,2. \\ d\,3,\ d\,4,\ m\,1,\ m\,2. \end{matrix}\right.$
II.	$\frac{6-6}{5-5}$	viz.	$\left\{\begin{matrix} p\,2,\ p\,3,\ p\,4,\ m\,1,\ m\,2,\ m\,3. \\ p\,3,\ p\,4,\ m\,1,\ m\,2,\ m\,3. \end{matrix}\right.$
III.	$\frac{5-5}{4-4}$	viz.	$\left\{\begin{matrix} p\,3,\ p\,4,\ m\,1,\ m\,2,\ m\,3. \\ p\,4,\ m\,1,\ m\,2,\ m\,3. \end{matrix}\right.$
IV.	$\frac{4-4}{4-4}$	viz.	$p\,4,\ m\,1,\ m\,2,\ m\,3.$
V.	$\frac{4-4}{3-3}$	viz.	$\left\{\begin{matrix} p\,3,\ p\,4,\ m\,2,\ m\,3. \\ p\,4,\ m\,2,\ m\,3. \end{matrix}\right.$
VI.	$\frac{3-3}{3-3}$	viz.	$p\,4,\ m\,2,\ m\,3.$
VII.	$\frac{2-2}{2-2}$	viz.	$p\,4,\ m\,3.$
VIII.	$\frac{1-1}{1-1}$	viz.	$m\,3.$

These observations prove that, contrary to the opinion of Home and Cuvier, the Wart-hogs have deciduous teeth, succeeded vertically by premolar teeth; in the *Phacochærus Æliani*, at least, three deciduous teeth are, in some individuals, succeeded by as many premolar teeth; and, as a general rule, two deciduous teeth are displaced vertically by two premolars. The first true molar is remarkable for its unusually early development, which is followed by an unusually early abrasion and expulsion, when its place is obliterated by the second true molar being pushed forwards into contact with the last premolar. This tooth is as remarkable for its longevity, and remains after the wearing away and shedding of the second true molar, when the last true molar advances into contact

with the last premolar, and the place of both the previously intervening true molars is obliterated. This unusual order of shedding of the molar teeth has given rise to the idea of the last large and complex true molar of the *Phacochœrus* being the homologue of both the last and penultimate grinders of the common Hog, which the author's observations refute; and he, also, is able to point out, by re-examination of the original specimen figured by Home in the Phil. Trans., the source of the erroneous idea that the common Hog had an additional true molar behind the large one symbolised by *m* 3, in the author's system of dental notation.

The nature and signification of the symbols proposed are explained and illustrated by a series of drawings. One of the fruits of the determination of the homology of a part is the power of giving it a name, and signifying it by a symbol applicable co-extensively with such homology. The limits are shown within which the homologies of individual teeth can be determined: they present the requisite constancy of character in a large proportion of the class Mammalia. Certain members of this class, *e.g.* the order *Bruta* and the *Cetacea vera*, have teeth too numerous and alike in form and mode of development to admit of being determined individually from species to species. Such mammalia have but one set of teeth, and the author proposes to call them 'Monophyodonts.' On the other hand, the orders *Marsupialia, Insectivora, Rodentia, Ruminantia, Pachydermata, Carnivora, Cheiroptera, Quadrumana* and *Bimana* have two sets of teeth, and might be called collectively, 'Diphyodonts.' Of the permanent teeth of this division of mammalia, some succeed the deciduous teeth vertically, others come into place behind one another in horizontal succession. The 'incisors' are determined by a character of relative position to the jaws and to each other: so likewise the 'canines.' The remaining teeth are divided into those which are developed in vertical relation to the deciduous molars, and push them out, and those that have not such relation, but follow each other horizontally: the term 'molar' is restricted by the author to these latter teeth, and that of 'premolar' to the former ones, which are always anterior to the molars. There is a remarkable degree of constancy in the number of these different kinds of teeth; in the placental Diphyodonts, *e. g.* the 'incisors' never exceed $\frac{3-3}{3-3}$, *i. e.* 3 on each side of both jaws, the 'canines' $\frac{1-1}{1-1}$, the premolars $\frac{4-4}{4-4}$, the molars $\frac{3-3}{3-3}$, $=44$; and this the author regards as the typical formula of dentition in the great proportion of the mammalian class above defined. It was rarely departed from by the primæval species that have become extinct, and is modified chiefly by defect or loss of certain teeth in the existing species. When the grinders are below the typical number, the missing molars are taken from the back part of their series, and the premolars from the fore part of theirs: the most constant teeth being the fourth premolar and first true molar; these are always determinable, whatever be their form, by the relation to them of the

last tooth of the deciduous series. Thus determined, the homologies of the other grinders are ascertained by counting the molars from the first backwards, 1, 2, 3; and the premolars from the last forwards, 4, 3, 2, 1. The symbols are made by adding the initial *m* to the numbers of the molar teeth, and the initial *p* to those of the premolar teeth. The author concludes by pointing out the advantages of this system of anatomical notation.

2. "Description of the Hydrostatic Log." By the Rev. E. L. Berthon, M.A. Communicated by Sir Francis Beaufort, F.R.S. &c., on the part of the Lords Commissioners of the Admiralty.

The object of this invention is to obtain a register of the speed of ships, by a column of mercury, in such a manner that the height of the column shall depend upon the velocity alone, and not be affected by any disturbing causes, such as alteration of draught of water, pitching and rolling, &c.

The principle embraces that of Pitôt's tube, inasmuch as the force of the resistance due to the velocity is communicated through a small pipe projecting into the water below the bottom of the ship: this force, acting upwards, compresses a portion of enclosed air in a small cylinder, which air communicating by means of a little pipe with the bulb of a glass tube—bent like a common barometer—raises the mercury in the tube, by depressing it in the bulb.

But as any single column of water and air thus acting upon the surface of the mercury in the *bulb alone* must depend not only upon the resistance due to the velocity, but also upon the *distance of the cylinder from the water-line*, which distance or height varies with every sea, and alters more permanently as the draught of water changes, a compensation was necessary; and the inventor has found one, which he considers perfect for all these variations, by applying *a second column of water and air* to press upon the *other surface of the mercury*, viz. that in the glass tube. This second column is precisely like the first as regards the pipe and cylinder, and communicates with the sea by an aperture or apertures, presented in such a direction that velocity does *not produce any increase of pressure*. Thus the mercury in the indicator is placed *between* TWO *columns* of water and air, which are *always equal to each other* in length, and the mercury rises according to the *difference* between the pressures upon its two surfaces, the result of resistance or velocity alone.

The air-pipes may be conducted in any direction, and the indicator, which swings upon gimbals, may be placed in any part of the ship. The two water-pipes are conducted into one tube in the bottom of the ship, divided into two separate chambers for the different forces.

In addition to the speed, the true course or leeway of the vessel is indicated upon a horizontal segment divided into degrees, over which a needle is moved by a rod connected with the above-mentioned double tube; and the whole is kept continually in the true direction of the ship's motion by a float or vane attached to the lower end of the tube in the water.